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PROJECT MEMORANDUM

DATE: December 19, 2013

FROM: Steven Harrison, PE – David Evans and Associates, Inc.

TO: South Cooper Mountain Technical Advisory Committee

CC: South Cooper Mountain Project Management Team

SUBJECT: **Sanitary Sewer Scenario Evaluation – Summary Findings and Planning Level Cost Estimates**

PROJECT: **South Cooper Mountain Concept and Community Plans**

City of Beaverton #2752-13B

DEA PROJECT NO: APGI0000-0002

This memo provides information to support the evaluation of the initial three (3) scenarios for the South Cooper Mountain Concept Plan including estimated sanitary sewer design flows, and estimated pipe and pump station capacity and associated costs. This memo is related to the sanitary sewer infrastructure needs within the South Cooper Mountain planning area. Information was gathered from the City of Beaverton and Clean Water Services District (CWS) to identify their near term plans to provide adequate sanitary sewer capacity to serve the study area and to verify our cost assumptions.

Evaluation Assumptions

The scenarios depict conceptual land uses using "development types". We pared down the "development types" to five (5) basic types. The average daily sanitary sewer flows from each of these basic "development types" is given below:

Table 1. Average Daily Sanitary Sewer Flows from Basic Development Types

Generalized Development Type	Average Daily Sanitary Sewer Flow (gallons/day/unit)	Average Daily Sanitary Sewer Flow (gallons/day/employee)	Average Daily Sanitary Sewer Flow (gallons/day/student)
Single Family Neighborhoods	360		
Compact Neighborhoods	295		
Urban Neighborhoods	212		
Commercial Development		45.8	
Schools			15

(Typical Average Daily Flows are between 100-125 gpcd. The above assumptions resulted in 140 gpcd based on the population)

Because sanitary sewer flows fluctuate throughout the day, the peak hourly design flow rate is obtained by multiplying the average daily rate by a peaking factor. Based on the anticipated population of the planning area, the peaking factor can range from 1.8 to 5.5.[1] A larger population requires a smaller peaking factor. Given that the South Cooper Mountain planning area is relatively small (adding between 6,200 and 9,300 housing units), we used a peaking factor of 4.0.

[1] Source: Babbitt, H.E., "Sewerage and Sewage Treatment". 7th ed., John Wiley & Sons, Inc. New York (1953).

Based on industry accepted design principles, we assumed the minimum pipe size would be 8-inches in diameter with a minimum slope of 0.5%. We also evaluated existing contours along the roadway alignments to determine potential roadway, and associated sewer, grades/slopes. We used this information to estimate future pipe capacity. Where possible we avoided sanitary sewer creek crossing. However, there were instances where a creek crossing was required. In most cases we ran the new sanitary lines along the creek top of bank.

The unit cost for the sanitary sewer system was provided by the City of Beaverton and is on a per linear foot basis and includes manholes at 200-foot intervals and service laterals at 50-foot intervals. The unit costs also include miscellaneous items such as utility relocation, abandoning of existing facilities, etc.; 15% increase for general contractor profit and overhead; 25% increase for engineering and administration; and a 30% increase for general contingency.

Table 2. Gravity Sanitary Sewer Unit Costs

PVC Pipe Diameter (Inches)	Unit Cost ($/LF)
8	255
12	311
15	354

Sanitary Sewer System Overview by Subarea

As we have established in previous memoranda, there are three (3) subareas defined in this study. They are, as shown on the attached scenario analysis maps, “North Cooper Mountain”, “Urban Reserve Area”, and “South Cooper Mountain Annexation Area”. Generally, the overall sanitary sewer system will flow by gravity towards future pump stations (Tile Flat Road Pump Station or River Terrace Pump Station) or to a 21” line in Scholls Ferry Road and eventually to the Durham Waste Water Treatment Plant.

North Cooper Mountain (NCM)

This area is largely developed with existing single family homes on large lots that are currently utilizing septic systems for sanitary sewerage disposal. The need for a public sanitary sewer system to serve this area may come from two factors: failure of the existing septic systems[2] and/or future growth at urban densities. We have evaluated potential future sanitary sewer locations and where these systems may connect to adjacent existing systems. We also differentiated the new sanitary sewer needed due to septic system failure compare to new sanitary sewer needed due to new development as shown in the scenario analysis maps.

Urban Reserve Area (URA)

This area includes the Cooper Mountain Nature Park and several dozen single family homes on large lots in the vicinity of SW 175th Avenue. Based on the natural terrain of this subarea, connections can be made along the east boundary, through the South Cooper Mountain Annexation Area within SW Scholls Ferry Road, to the future River Terrace Pump Station or Tile Flat Road Pump Station systems. These connection points are shown in the scenario analysis maps.

[2] Septic systems typically last approximately 50 years before they require replacement. Failure of septic systems within an urban area requires connection to a public sewer; replacement with a new septic system is not allowed.

South Cooper Mountain Annexation Area (SCMAA)

This subarea is mostly undeveloped. Based on the natural terrain, connections can be made at SW Scholls Ferry Road or to the future River Terrace Pump Station system. These connection points are shown in the scenario analysis maps.

Future Pump Stations

Clean Water Services has evaluated the South Cooper Mountain area and has determined that in order to meet the service requirements of both the URA and SCMAA, two new pump stations (Tile Flat Rd Pump Station and River Terrace Pump Station) will be required. The Tile Flat Road Pump Station will be located at the low point (creek intersection) of Tile Flat Road. This pump station is anticipated to pump to the east along Tile Flat Road to a gravity system that will eventually convey sewage to the new River Terrace Pump Station.

The River Terrace Pump Station will be located within the urban growth boundary along the creeks south of SW Scholls Ferry Road and west of SW Roy Rogers Road (the final location for this pump station has not yet been determined). The River Terrace Pump Station is anticipated to be in operation by the end of 2015, and all flows from this proposed pump station will be directed to the intersection of Scholls Ferry Road and 175th Avenue to connect to the 21-inch Scholls Ferry Road Sanitary Sewer Extension and ultimately to the Durham Wastewater Treatment Plant. Location and timing of this facility should be coordinated closely with the City of Tigard in that it is concurrently developing an urbanization plan for the River Terrace area, directly south of SW Scholls Ferry Road along SW Roy Rogers Road. Based on a CWS study conducted by CH2M Hill in March 2013, regardless of the inclusion of the Cooper Mountain sanitary flows, significant improvements are required to the Summer Creek trunk line extending east to SW 121st Avenue. The study states improvement diameter sizes will rand from 21 to 42 inches

Pump stations can be expanded to add capacity relatively easily, so the initial designs are assumed to serve only the projected growth within the existing UGB. The pump stations could then be expanded to provide capacity to serve the Urban Reserve Area in the future. The design and construction costs for these pump stations will be estimated both for the full build-out of the Urban Growth Boundary (20 years) and the build-out of the Urban Reserve Area (50 years).

Scenario Comparisons

The primary difference between the three (3) scenarios is due to the varied location of the major roadway alignments, and density and location of new development. The pipe sizing is based on contributing sanitary flow and anticipated pipe slope.

Scenario 1

Scenario 1 includes new 8-inch sanitary sewer lines within North Cooper Mountain area. There is no new development occurring in this area. All of these new sanitary lines are needed due to existing septic system failure. The southern part of NCM area will be conveyed south to the new Tile Flat Road Pump Station.

The URA Grabhorn Meadow area is served by new 8-inch sanitary lines along the creek and within Grabhorn Road. The low area south of the creeks is served by several 8-inch sewer lines. The Hilltop area is served by several connection points. The Hilltop area with natural grades that slope to the north will be served by new 8-inch sewer pipe and two (2) connection points within Kemmer Road. The area of Hilltop with natural slope to the south connects to a new 8-inch and eventually to a 12-inch line within 175th Avenue. There is also an 8-inch sanitary line along the south (low side) of the Hilltop area. The

area east of the creeks and south of the Hilltop area is also served by an 8-inch line. The 175th Avenue sanitary sewer line mainly serves properties adjacent to the roadway. There are several lengths of 8-inch sewer lines along the east boundary of the study area connecting at six (6) different locations.

The SCMAA will be served by many different sewer line locations. The Beaverton School District has near term plans to build a new high school in the area just north of SW Scholls Ferry Road and east of SW 175th Avenue starting as early as 2015. This area can be served by the existing 21-inch gravity sanitary sewer located in SW Scholls Ferry Road. The area east of 175th Avenue and north of Scholls Ferry Road will be served by a new 12-inch sewer line located in 175th Avenue and two (2) connection points in SW Scholls Ferry Road. With the exception of the high school area, the areas west of 175th Avenue will eventually be conveyed to the new River Terrace Pump Station. The new east-west collector will include an 8-, 12-, and 15-inch sewer lines. A 15-inch line will also be located in SW Tile Flat Road serving adjacent properties and will eventually accept force main flow from the Tile Flat Road Pump Station. The low lying creek will have 8-inch sanitary sewers on each side to convey waste water south to the low point in Scholls Ferry Road. From this point the sanitary sewer flows will be conveyed to the River Terrace Pump Station.

Table 3. Scenario 1 - Gravity Sanitary Sewer Infrastructure Costs

North Cooper Mountain			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	37,394	255	$9,535,470
		Subarea Total:	**$9,535,470**
Urban Reserve Area			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	63,142	255	$16,101,210
12	7,270	311	$2,260,970
		Subarea Total:	**$18,362,180**
South Cooper Mountain Annexation Area			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	14,124	255	$3,601,620
12	11,019	311	$3,426,909
15	4,401	354	$1,557,954
		Subarea Total:	**$8,586,483**
		Total:	**$36,484,133**

Scenario 2

The northern NCM area includes several 8-inch sewer lines with seven (7) different points of connection in SW Gassner Road. These improvements are in part due to new development occurring in this area and also due to existing septic system failure. The southern part of NCM area also includes new 8-inch sewer lines that will convey waste water to the south to the new Tile Flat Road Pump Station. This area does not included new development and the new lines are shown due to existing septic system failure.

The URA Grabhorn Meadow area is served by new 8-inch sanitary lines along the creek and within Grabhorn Road. The low area south of the creeks is served by several 8-inch sewer lines. The realigned 175th Avenue bisects the Hilltop area, however, similar to Scenario 1, this area is served by several connection points. The Hilltop area with natural grades that slope to the north will be served by new 8-inch sewer pipe and two (2) connection points within Kemmer Road. The area of Hilltop with natural slope to the south connects to a new 8-inch in 175th Avenue and eventually to a 12-inch line along the downhill slope. The area east of the creeks and south of the Hilltop area is also served by an 8-inch line. The 175th Avenue sanitary sewer line mainly serves properties adjacent to the roadway, however, because of the realignment, there is more area to serve than in Scenario 1. There are several lengths of 8-inch sewer lines along the east boundary of the study area connecting at six (6) different locations.

The SCMAA will be served by many different sewer line locations. The Beaverton School District new high school can, as indicated in Scenario 1, be served by the existing 21-inch gravity sanitary sewer located in SW Scholls Ferry Road. The area east of 175th Avenue and north of Scholls Ferry Road will be served by a new 12-inch sewer line located in 175th Avenue and two (2) connection points in SW Scholls Ferry Road. Where the grades flatten out along 175th Avenue the sewer line will become 15-inches in diameter. With the exception of the high school area, the areas west of 175th Avenue will eventually be conveyed to the new River Terrace Pump Station. The new east-west collector will include an 8-, and 12-inch sewer lines. A 12-inch line will also be located in SW Tile Flat Road serving adjacent properties and will eventually accept force main flow from the Tile Flat Road Pump Station. The low lying creek will have 8-inch sanitary sewers on each side to convey waste water south to the low point in Scholls Ferry Road. From this point the sanitary sewer flows will be conveyed to the River Terrace Pump Station.

Table 4. Scenario 2 - Gravity Sanitary Sewer Infrastructure Costs

North Cooper Mountain			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	39,260	255	$10,011,300
		Subarea Total:	**$10,011,300**

Table 4, Continued

Urban Reserve Area			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	61,884	255	$15,780,420
12	8,807	311	$2,738,977
15	1,285	354	$454,890
		Subarea Total:	**$18,974,287**

South Cooper Mountain Annexation Area			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	16,095	255	$4,104,225
12	11,142	311	$3,465,162
15	5,416	354	$1,917,264
		Subarea Total:	**$9,486,651**
		Total:	**$38,472,238**

Scenario 3

The northern NCM area includes several 8-inch sewer lines with seven (7) different points of connection in SW Gassner Road. These improvements are in part due to new development occurring in this area and also due to existing septic system failure. The southern part of NCM area also includes new 8-inch sewer lines that will convey waste water to the south to the new Tile Flat Road Pump Station. These new 8-inch lines are also in part due to new development and to existing septic system failure.

The URA Grabhorn Meadow area is served by new 8-inch sanitary lines along the creek and within Grabhorn Road. The low area south of the creeks is served by several 8-, and 12-inch sewer lines. Like Scenario 2 the realigned 175th Avenue bisects the Hilltop area, however, the realignment is located further west than Scenario 2 and includes more area. Similar to both Scenarios 1 and 2 the Hilltop area with natural grades that slope to the north will be served by new 8-inch sewer pipe and two (2) connection points within Kemmer Road. The area of Hilltop with natural slope to the south connects to a new 8-inch and eventual 12-inch line in 175th Avenue. The Creeks area is served by an 8-inch line that conveys flow to the west to the Tile Flat Road Pump Station. The 175th Avenue sanitary sewer line mainly serves properties adjacent to the roadway. Like Scenario 2 the realignment has included more area of contribution and more sanitary sewer flow within the 175th Avenue sewer line. Similar to all three scenarios, there are several lengths of 8-inch sewer lines along the east boundary of the study area connecting at six (6) different locations.

The SCMAA will be served by many different sewer line locations. The Beaverton School District new high school can, as indicated in the previous scenarios, be served by the existing 21-inch gravity sanitary sewer located in SW Scholls Ferry Road. The area east of 175th Avenue and north of Scholls Ferry Road will be served by a new 12-inch sewer line located in 175th Avenue and two (2) connection points in SW Scholls Ferry Road. With the exception of the high school area, the areas west of 175th Avenue will eventually be conveyed to the new River Terrace Pump Station. The new east-west collector will include an 8-, and 12-inch sewer lines. The new north-south collector road extension from SW Vandermost Road will include a new 15-inch sewer line. A 12-inch line will also be located in SW Tile Flat Road serving adjacent properties and will eventually accept force main flow from the Tile Flat Road Pump Station. The sewer line from Tile Flat Road to the low point in Scholls Ferry Road will need to be 15-inches in diameter. The low lying creek will have 8-inch sanitary sewers on each side to convey waste water to the low point in Scholls Ferry Road. From this point the sanitary sewer flows will be conveyed to the River Terrace Pump Station.

Table 5. Scenario 3 - Gravity Sanitary Sewer Infrastructure Costs

North Cooper Mountain			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	39,089	255	$9,967,695
		Subarea Total:	**$9,967,695**
Urban Reserve Area			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	65,953	255	$16,818,015
12	11,244	311	$3,496,884
15	1,594	354	$564,276
		Subarea Total:	**$20,879,175**
South Cooper Mountain Annexation Area			
Pipe Diameter	**Total Length (ft)**	**Unit Cost ($/LF)**	**SubTotal**
8	19,931	255	$5,082,405
12	14,640	311	$4,553,040
15	4,201	354	$1,487,154
		Subarea Total:	**$11,122,599**
		Total:	**$41,969,469**

Table 6. Sanitary Sewer Infrastructure Cost Summary

Scenario	Cost
Scenario #1 Gravity Sanitary Sewer Costs (Tile Flat Rd P.S. is not included)	$36,484,133
Scenario #2 Gravity Sanitary Sewer Costs (Tile Flat Rd P.S. is not included)	$38,472,238
Scenario #3 Gravity Sanitary Sewer Costs (Tile Flat Rd P.S. is not included)	$41,969,469

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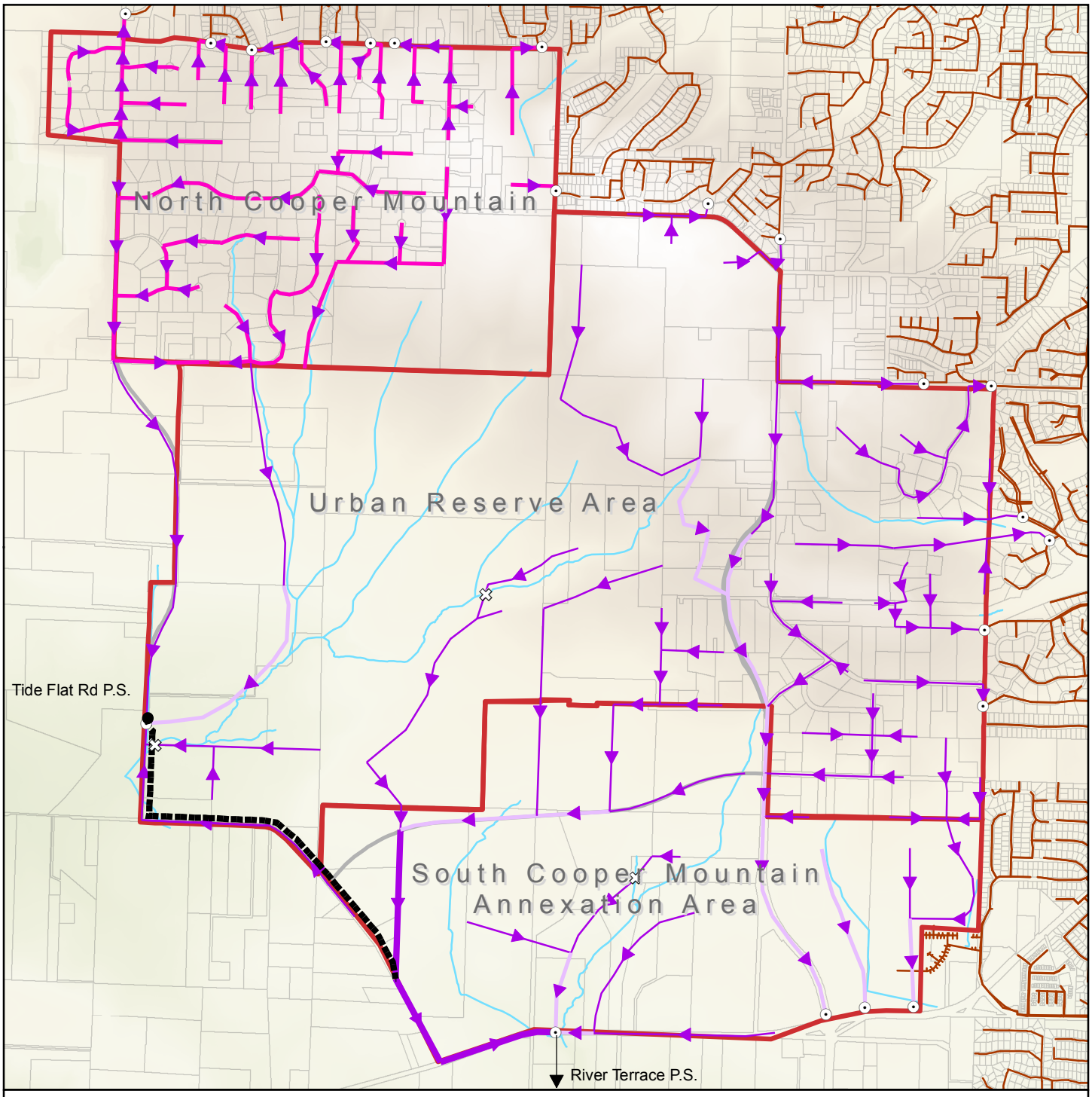

South Cooper Mountain Sanitary Sewers - Scenario 1

Proposed Pipe Location and Diameter

- Force Main
- 8-inch (new devel)
- 8-inch (septic failure)
- 12-inch
- 15-inch

- Point of Connection
- Stream Crossing
- Existing Stream
- New Arterial
- New Collector
- Existing Sanitary Sewer
- South Cooper Mountain Study Area
- Washington County Taxlot

Prepared By: David Evans and Associates, Inc.

Date: 11/7/2013

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

NORTH

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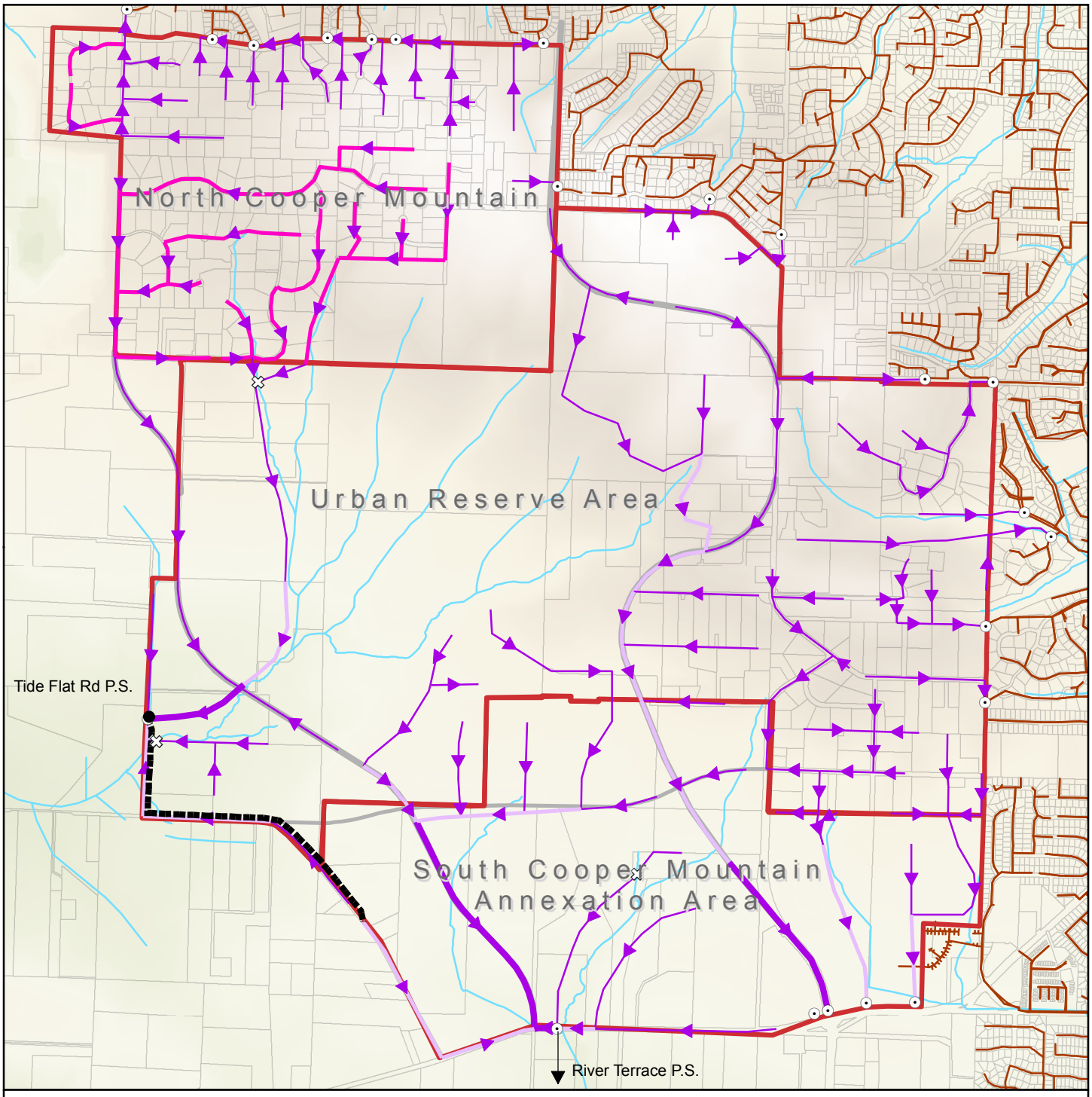


South Cooper Mountain Sanitary Sewers - Scenario 2

Proposed Pipe Location and Diameter

- Force Main
- 8-inch (new devel)
- 8-inch (septic failure)
- 12-inch
- 15-inch

- Point of Connection
- Stream Crossing 2
- Existing Stream
- New Arterial
- New Collector
- Existing Sanitary Sewer
- South Cooper Mountain Study Area
- Washington County Taxlot

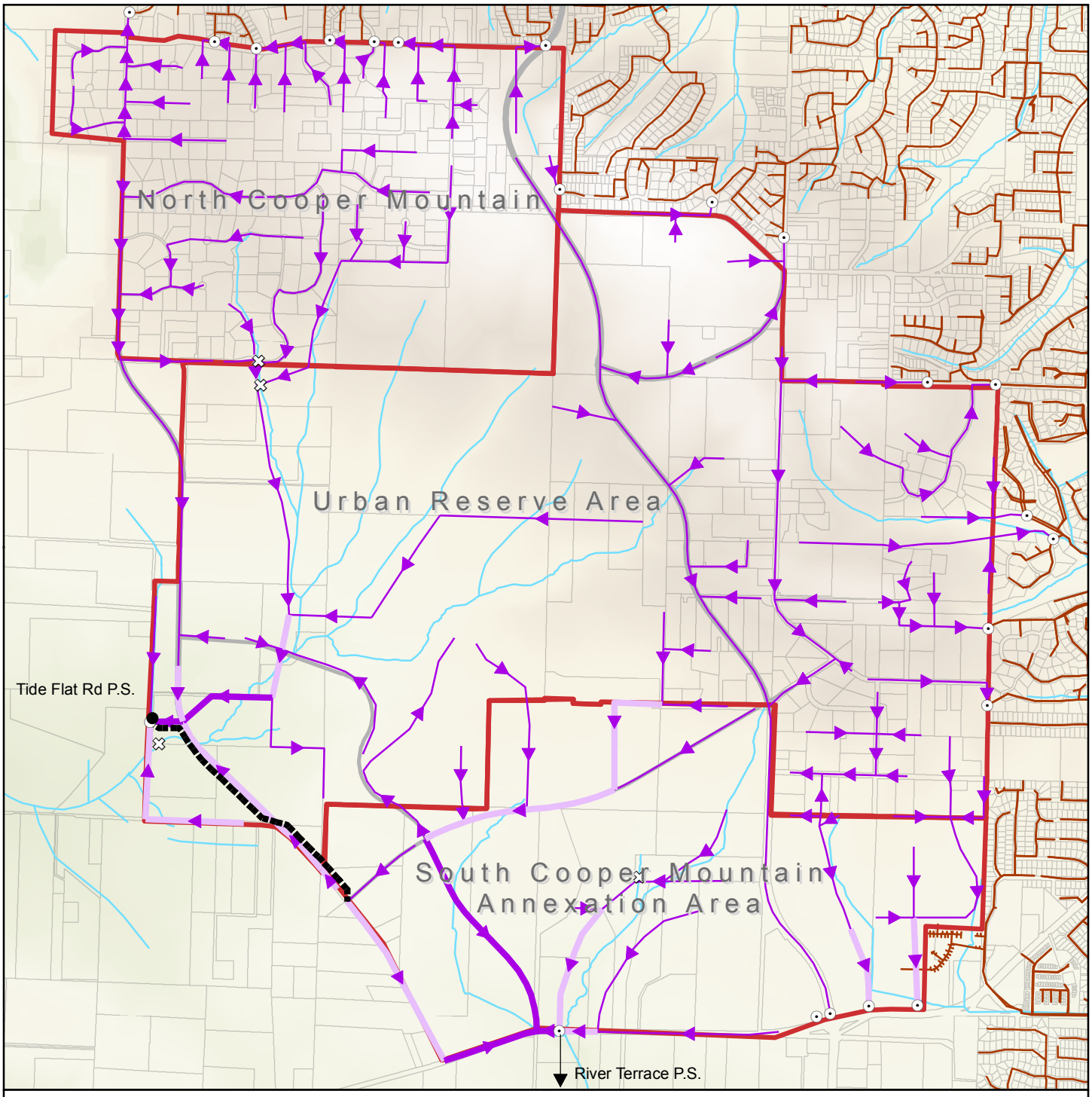
Prepared By: David Evans and Associates, Inc.

Date: 11/7/2013

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

NORTH

0 0.125 0.25 0.5 Miles



South Cooper Mountain Sanitary Sewers - Scenario 3

Proposed Pipe Location and Diameter

- Force Main
- 8-inch (new devel)
- 12-inch
- 15-inch

- Point of Connection
- Stream Crossing
- Existing Stream
- New Arterial
- New Collector
- Existing Sanitary Sewer
- South Cooper Mountain Study Area
- Washington County Taxlot

Prepared By: David Evans and Associates, Inc.

Date: 11/7/2013

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

NORTH

0 0.125 0.25 0.5 Miles